

COLONY OF MAURITIUS.

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REPORT

OF

CAPTAIN J. S. STEVENSON, I.M.S.,

ON INOCULATION WITH

HAFFKINE'S PROPHYLACTIC.

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Report of Dr. Stevenson on inoculation with Haffkine's prophylactic.

CAPT., J. S. STEVENSON, I.M.S., TO THE DIRECTOR,
MEDICAL AND HEALTH DEPARTMENT.

The Director,
Medical and Health Department.

I have the honour to submit the following report on the results obtained by inoculation with Haffkine's prophylactic in the Colony, as far as I have been able to gather information on this head. Inoculation has never been very popular and has been performed in a desultory fashion, due partly to the scattered nature of the epidemic and partly to dislike on the part of the people to undergo the operation. No large community has been inoculated *in toto*, and it has been impossible to undertake any such ideal experiments as were performed in India, when inoculation was a new remedy. Necessarily, therefore, the calculation and conclusions which follow will appear somewhat laboured to persons who prefer experiments of the type carried out in Byculla Jail by Professor Haffkine. In the absence of the possibility of any such perfect demonstration here, one must do the best one can with the material at hand and I think that no open-minded person who studies with any degree of care the figures which follow, can have any doubt in his mind that inoculation in Mauritius has been as successful as inoculation in India and that Professor Haffkine's prophylactic has done all that has ever been claimed for it. With regard to this last it is important to understand what has really been claimed for the vaccine in point of view of many misconceptions which exist on this head.

First of all, extraordinary as it may appear, it is necessary to point out that Haffkine's fluid is primarily a *prophylactic* and not a curative agent, and that its curative action is merely incidental to its being a good prophylactic. Inoculation has been tried now for some years in India on all kinds of scales. The results have been uniform giving a case incidence protection of between 75 o/o and 85 o/o; and a mortality incidence protection of at least 20 o/o. I think these figures represent the minimum beneficial effects of the vaccine and that even higher percentages of protection have been obtained on various occasions. I entirely believe in the truth of the claims as above stated, and I would believe in them from what I have seen of inoculation in Mauritius alone and even if I had never heard or read of inoculation in India.

Attached are : 1o. A chart which shows the general course of the epidemic in Port Louis with its rise and fall. 2o. A list of inoculated plague cases with other information. Inoculation in Town will first be dealt with and then inoculation in country districts with conclusions drawn from both.

Finally some reference will be made to the manner in which the vaccine has been administered, its effects apart from prophylaxis, &c.

As will be seen the Town figures are so very uncertain that it is impossible to draw conclusions from them. The most important part of what follows, as regards accuracy of figures, rests with certain Dock communities and Sugar Estates where correct figures were obtainable.

Total number inoculated in the Colony :—

Port Louis	...	...	...	...	6,816
Country districts	...	...	...	...	10,843
Troops of Garrison	...	...	...	...	1,759
Total					19,418

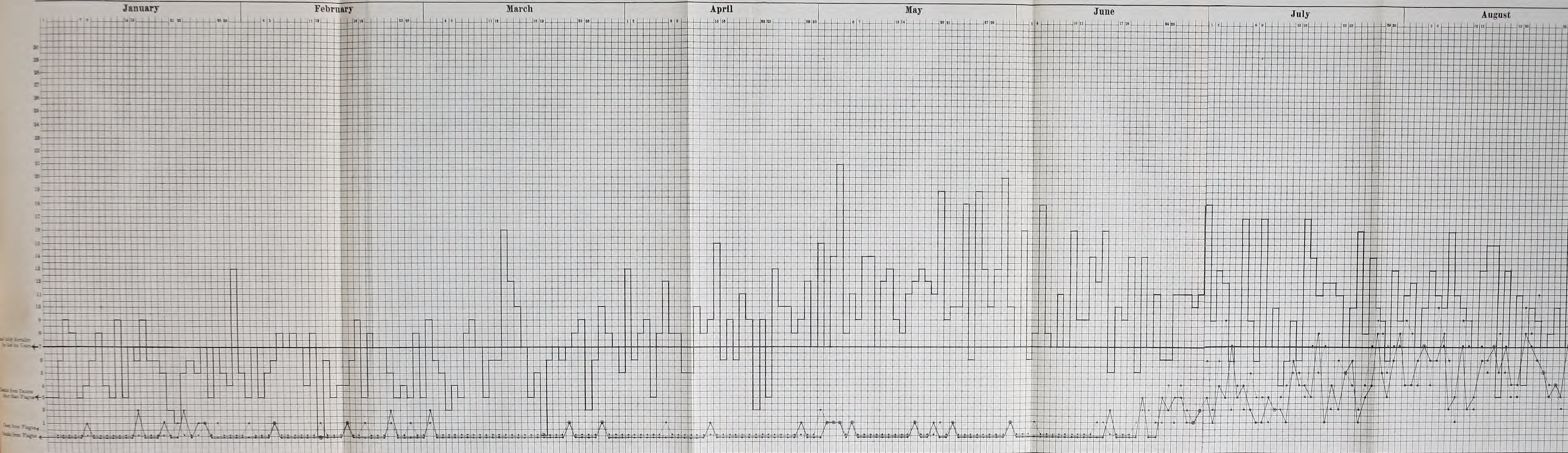
The above may be sub-divided as follows exclusive of the Troops of Garrison :—

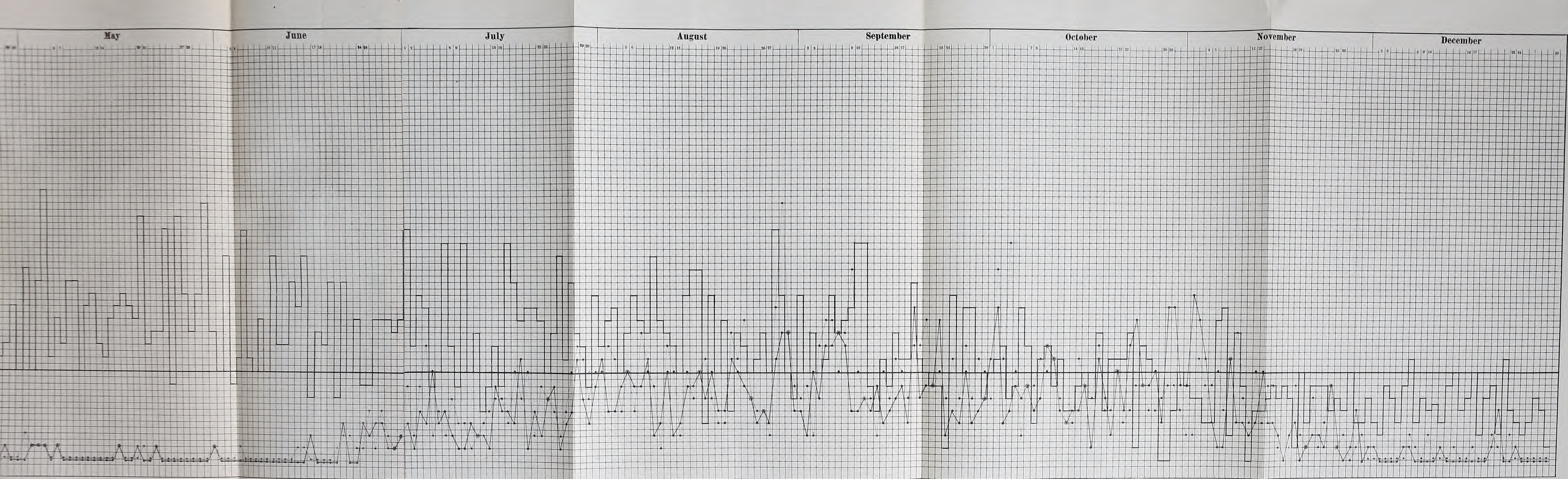
Europeans	...	...	...	...	141
Mauritians	...	...	...	...	8,328
Indians	...	...	...	...	8,822
Chinese	...	...	...	...	368
Total					17,659

30th. January, 1900.

J. S. STEVENSON,

Captain, I.M.S.





Cases of Plague which have occurred amongst inoculated persons in Port Louis.

Serial No.	Case Book No.	Name.	Inoculation No.	Date of Inoculation.	Date of 1st symptoms.	Remarks.
...	123	M. D. M.	2934	15.7.99	16.7.99	D. 17.7.99
1	151	G.	253	3.7.99	20.7.99	D. 23.7.99
2	179	E.	1579	10.7.99	Suppurating bubo 30.7.99	D. 28.7.99 (Mauritius Dock)
3	201	A.	1243	8.7.99	30.7.99	Cured 2.10.99 (do.)
4	207	G.	2191	11.7.99	23.7.99	Cured 31.8.99 (do.)
5	206	M.	3417	19.7.99	30.7.99	D. 1.8.99 (do.)
6	226	C. S.	3447	19.7.99	3.8.99	Cured 12.9.99 (do.)
7	237	S. V.	1614	10.7.99	3.8.99	D. 6.8.99 (Albion Dock)
8	265	S.	1229	8.7.99	7.8.99	D. 11.8.99 (Mauritius Dock)
9	298	C. C.	1980	10.7.99	13.8.99	Cured 4.9.99
10	287	L. P.	28	9.5.99	11.8.99	D. 14.8.99
11	324	S. L.	4139	24.7.99	19.8.99	Cured 27.9.99 (Mauritius Dock)
12	327	C.	1297	7.7.99	19.8.99	D. 22.8.99 (Albion Dock)
13	343	V.	5168	10.8.99	.....	D. 23.8.99 (Camp de Barran)
14	350	M. J.	1821	10.7.99	22.8.99	Cured 11.9.99
15	356	S.	2642	13.7.99	.....	D. 23.8.99 (Camp de Barran)
16	372	B. M.	138	30.6.99	26.8.99	Cured 12.10.99
17	376	P. E.	3608	20.7.99	25.8.99	Cured 2.10.99 (Mauritius Dock)
18	377	N. M.	3785	21.7.99	7.8.99	Cured 2.10.99 (do.)
19	402	A.	1475	8.7.99	28.8.99	Cured 14.10.99 (Albion Dock)
20	406	A. C.	4138	24.7.99	.....	D. 30.8.99 (do.)
21	425	T.	386	4.7.99	30.8.99	Cured 30.9.99 (do.)
22	459	Ww. B.	5930	22.8.99	1.9.99	Cured 11.9.99
23	458	A.	2083	11.7.99	3.9.99	Cured 2.12.99 (Mauritius Dock)
24	461	D.	3051	17.7.99	2.9.99	D. 6.9.99 (Colonial Dock)
25	474	A. A.	1258	8.7.99	4.9.99	D. 7.9.99 (Mauritius Dock)
26	518	S. P.	3256	17.7.99	8.9.99	Cured 3.10.99 (do.)

Cases of Plague, &c.—(Contd).

Serial No.	Case Book No.	Name.	Inoculation No.	Date of Inoculation.	Date of 1st. symptoms.	Remarks.
27	504	R.	1883	10.7.99	7.9.99	D. 13.9.99 (Colonial Dock)
28	505	D. D.	2275	11.7.99	8.9.99	D. 26.9.99 (do.)
29	512	S. R.	3312	18.7.99	3.9.99	Cured 16.10.99
30	535	R., R.	3437	19.7.99	13.9.99	D. 19.9.99 (Colonial Dock)
31	536	S.	1833	10.7.99	13.9.99	D. 14.9.99 (do.)
32	537	B.	3927	21.7.99	13.9.99	Cured 21.10.99 (do.)
33	558	L.	391	5.7.99	14.9.99	Cured 22.11.99 (do.)
34	563	M. M.	3044	17 7.99	15.9.99	D. 19.9.99 (do.)
35	550	R., M.	3597	19.7.99	15.9.99	D. 21.9.99
36	569	A.	2637	13.7.99	16.9.99	D. 19.9.99
37	593	M.	1895	10.7.99	19.9.99	Cured 14.10.99 (Colonial Dock)
38	596	G. M.	2759	13.7.99	18.9.99	D. 23.9.99
39	616	M.	430	4.7.99	18 9.99	D. 21.9.99 (Colonial Dock)
40	617	P., C.	223	3.7.99	19.9.99	Cured 18.10.99
41	656	B., M.	1181	7.7.99	23.9.99	D. 27.9.99
42	680	L. M.	4034	22.7.99	28.9.99	D. 7.10.99
43	683	E.	1323	8.7.99	29.9.99	D. 30.9.99 (Albion Dock)
44	684	P. D. M.	2208	11.7.99	25.9.99	D. 30.9.99 (Mauritius Dock)
45	708	A.	2045	11.7.99	30.9.99	D. 6.10.99 (Albion Dock)
45 bis	733	K.	2603	13.7.99	2.10.99	Cured 21.10.99 (do.)
46	759	Miss C. Z.	4415	26.7.99	4.10.99	Cured 9.11.99
47	787	S.	1681	10.7.99	8.10.99	Cured 2.12.99 (Albion Dock)
48	797	G.	2564	13.7.99	8.10.99	Cured 1.11.99 (do.)
49	798	G.	2591	13.7.99	8.10.99	D. 10.10.99 (do.)
50	800	V.	1259	8.7.99	7.10.99	Cured 2.11.99 (do.)
51	822	S., K.	10340	25.9.99	.....	D. 11.10.99
...	869	S.	11817	13.10.99	14.10.99	D. 18.10.99
			11877			

Cases of Plague, &c.—(Contd).

Serial No.	Case Book No.	Name.	Inoculation No.	Date of Inoculation.	Date of 1st. symptoms.	Remarks.
52	881	P.	11427	5.10.99	16.10.99	Cured 2.11.99
53	883	R.	16180	10.7.99	17.10.99	Cured 20.11.99
54	884	A.	3485	19.7.99	17.10.99	D. 18.10.99
55	923	K.	11788	9.10.99	20.10.99	D. 24.10.99
...	957	<i>M. B. R.</i>	11807	13.10.99	.....	D. 22.10.99
56	975	I. M.	2692	13.7.99	18.10.99	D. 23.10.99
57	976	Mrs. S. T.	1807	20.7.99	20.10.99	D. 24.10.99
58	982	J. B.	7048	3.9.99	.....	D. 24.10.99
59	987	K. O.	2469	12.7.99	20.10.99	D. 24.10.99
60	1015	M. S.	10792	30.9.99	25.10.99	Cured 9.11.99
61	1025	R. A.	2383	12.7.99	26.10.99	D. 30.10.99
62	1108	Ed. H. D.	852	6.7.99	30.10.99	D. 4.11.99
63	1211	I. M.	7148	4.9.99	13.11.99	Cured 23.11.99
64	1251	G. N.	539	4.7.99	18.11.99	D. 21.11.99
65	1270	R. O.	415 bis	4.7.99	15.11.99	Cured 27.12.99
66	1284	L. F.	2792	14.7.99	24.11.99	D. 27.11.99

Cases of Plague amongst inoculated persons in Country Districts.

Serial No.	Case Book No.	Name.	Inoculation No.	Date of Inoculation.	Date of 1st. symptoms.	Remarks.
1	1121	H. B.	7047	3.9.99	4.11.99	Cured 5.12.99
2	1122	E. B.	8032	10.9.99	4.11.99	D. 8.11.99
3	1322	M. D.	282	3.7.99	26.11.99	D. 3.12.99
4	1375	M. A.	15390	3.12.99	12.12.99	Cured 14.1.00
5	1411	A. R.	15367	3.12.99	20.12.99	D. 23.12.99
6	1424	V. V.	12236	15.11.99	29.12.99	D. 4.1.00
7	1078	R. H.	11334	5.10.99	31.10.99	Cured 25.11.99
8	1203	A.	11320	5.10.99	13.11.99	D. 15.11.99
9	13	V.	13319	18.11.99	11.1.00	Cured 29.1.00

Persons whose names are in italics are not counted, as being inoculated during incubation period.

REPORT.

INOCULATION IN PORT LOUIS.

Inoculation was commenced early in May and has been continued up to date. Until the end of June, however, the population came only in small numbers, and the statistics which follow apply only to the period between 1st. of July last and December 30th. inclusive, a period which corresponds to the most serious rise in the plague death-rate and its gradual decline to normal.

The figures below are taken in part from the Registrar General's returns, and in part from the books of the Medical Inspector, Dr. Lorans.

No. of persons inoculated in Port Louis.	No. of cases of plague amongst inoculated in Port Louis.	No. of deaths from plague amongst inoculated in Port Louis.	No. of persons uninoculated in Port Louis.	No. of cases of plague amongst uninoculated in Port Louis.	No. of deaths from plague amongst uninoculated in Port Louis.
6,816	66	38	47,184	826	708

Total population of Port Louis = 54,000.

These figures give the following result as regards case incidence and mortality incidence. Case incidence protection of inoculated population over uninoculated population 44 o/o.

Death-rate from plague amongst inoculated population 57 o/o.

Death-rate from plague amongst uninoculated population 86 o/o.

As regards mortality incidence the results may be taken as good, giving an advantage in favour of inoculation of 29 o/o.

This in the most fatal specific fever known to medicine, and one which yields to no drug or other treatment whatever as the experience of India has well shown.

It remains to discuss the case incidence, and to explain if possible why a protection percentage of 44 has been obtained in this Colony, whereas in India an advantage of between 75 o/o and 85 o/o has with perfect regularity resulted from the treatment of plague stricken communities with Haffkine's prophylactic.

Apart from the fact that only $\frac{1}{10}$ th of the whole population of the Town has been inoculated there would appear to be four points having an important bearing upon the figure 44 above.

1o. That the inoculated portion of the population has lived under conditions which rendered it more liable to infection than the uninoculated population. The Dock labourers and their families were inoculated "en masse" very early in the epidemic to the number of about 1,500.

The Dock labourers work on wharves and in rat infected go-downs. They live in barracks which more closely resemble the chawls of Bombay than do anything else in this Island.

Theirs was the first community to develop plague outside the original infected area of Camp Yoloff, and living as they do in camps and barracks a case of plague in their midst must necessarily, from multiplication of points of contact, be liable to infect much larger numbers than can a case occurring amongst the general population. In this connection it must be noted that of the total number of inoculated persons who have taken plague in Town no less than 35 were Dock labourers and only 31 belonged to the general population. In addition to the Dock labourers, the whole of the plague staff from disinfecting coolies upwards have been inoculated almost without exception.

As regards the general population naturally those people who were most terrified came to be inoculated, and they were most terrified who had cases of plague next door to them.

The bulk therefore of inoculated persons came from badly infected areas and lived under conditions rendering them very liable to take plague, whilst the uninoculated portion of the population lived in the less infected parts of the Town and being without the stimulus of fear naturally failed to present themselves at the inoculation station.

It comes to this that when of a large community a small percentage only is inoculated figures cannot be representative.

With small communities it is different, as it is possible then to gaze at and correct fallacies, but when one comes to deal with fifty or sixty thousand people nothing less than 50 o/o of inoculations can give results of real value. With a smaller percentage of inoculation there must always be possibilities of fallacy, and such fallacy can never produce error in the direction of over estimating the value of inoculation but always in the opposite direction.

20. The second point which bears upon the figure 44 above is that death certification in Port Louis has been so thoroughly bad that 300 cases of plague have been concealed since July 1st. last at the *very lowest possible estimate*. The figure is obtained by calculating the number of deaths apart from plague in excess of the normal daily average for the last 10 years (vide chart), and it represents the *lowest possible estimate* because it is calculated from death returns alone and not case returns and because 20 o/o of Mauritius plague recovers.

30. The third point bearing upon the figure 44 is that 10 of the plague stricken inoculated (vide list) developed plague within 10 days of inoculation. Now it is the opinion of many eminent bacteriologists that Haffkine's fluid does not begin to assert its full prophylactic action until 10 days or a fortnight after inoculation has been performed.

If therefore the average period of inoculation of plague is taken as being four days then it is reasonable to rule that inoculated persons developing plague within fourteen days of inoculation should not be returned as such, but as being uninoculated. The application of any such rule to the statistics of Port Louis would of course make the greatest possible difference to

the result inasmuch as plague seizures amongst the inoculated would be lessened by 16 o/o.

4o. The fourth and last point to which it is necessary to draw attention is that plague has caused an exodus from Town and that, altho' the figure 54,000 (Registrar General's return) may have represented the population of Port Louis in January last it has not represented the population during the last 4 or 5 months.

Short of a census it is of course impossible to know exactly what the population is, but from various sources it is estimated that the exodus has reduced it by between 5,000 and 10,000. Any such reduction will, of course, make a difference in the numbers of the inoculated community and decrease the case incidence amongst the inoculated as against the uninoculated proportionately. If it be permissible in the absence of certainty to make guesses, and to guess that panic exodus has reduced the Town population by 7,500 and if in addition it be granted that 300 cases of plague have been concealed, and finally that ten of the plague seizures returned as inoculated should not be so returned (as referred to in para. 3) then we get the following figures :—

Persons inoculated.	Cases.	Persons uninoculated.	Cases.
6,816	56	37,184	1,126

for which the case incidence protection conferred by Haffkine's prophylactic works out to over 70 o/o, a result generally comparable to that obtained in India.

But as already stated the numbers inoculated in Town represent so small a percentage of the total that no statistics can be made from the figures as they stand. There are only two things certain : 1o. that 44 o/o represents the minimum possible beneficial result of Haffkination obtained in Town as regards case incidence, and 2o. that whereas 86 o/o have died amongst the plague stricken uninoculated only 57 o/o have died amongst the plague stricken inoculated.

The case of Mauritius Dock Camp.

In this camp live at present 358 persons all told, mostly Madrasses and Indian musulmans. They are all engaged labourers and their families. The dwelling houses comprise a dozen or more barrack-like buildings, placed at short intervals, and covering 5 or 6 acres of ground. Some of the buildings are double storied and all are very dark, ill-ventilated and generally insanitary.

A barrack holds a dozen families or so living in separate cubicles in some of which latter no light ever enters. The first case of plague in this camp occurred on the 6th. of July last but previous to that date cases had been discovered in the Dock adjoining. The last case of plague in the camp occurred in November 21st. Inoculation was commenced on the 1st. of July and was rapidly and almost entirely completed ; inoculated

persons, contacts of plague being granted the privilege of optional segregation.

At the end of September about ninety people left the camp, and went into an evacuation camp where they remained. It is necessary therefore to give two sets of figures, viz: the figures as they stood before the above partial evacuation was commenced and the figures as they stand now:

Figures before partial evacuation.

Total number in camp 423

	No.	Cases.	Deaths.
Inoculated ...	423	13	6
Uninoculated....	13	7	6

The 13 uninoculated persons included some temporarily sick and some who entirely refused inoculation.

As the figures stood in September they give an advantage in favor of Haffkination of over 90 o/o. To make the case and mortality incidences of inoculated and uninoculated in this camp equal no less than 228 cases of plague would have to have occurred amongst the inoculated instead of 13, and of these 195 would have to have died instead of 6.

Figures as they stand now.

Total number in camp 358.

	No.	Cases.	Deaths.
Inoculated ...	319	13	6
Uninoculated ...	39	8	7

By the end of September plague had almost ceased in the neighbourhood of the camps, and the increase in the number of the uninoculated is due to new laborers and their families being engaged and not being inoculated. 8 of the 39 uninoculated are infants in arms.

As compared with the first set of figures, the occurrence of a fresh case of plague in an uninoculated labourer, and its fatal termination, improves the result as regards mortality incidence, whilst the advent of newly engaged uninoculated laborers after the camp had become practically a non-infected locality reduces the case incidence protection to 80 o/o.

Below is a table showing the cases of plague which occurred in this camp with the number of contacts of each case, &c.

No. of dwelling.	No. of persons inoculated.	Cases amongst inoculated.	Deaths amongst inoculated.	No. of persons uninoculated.	Cases amongst uninoculated.	Deaths amongst uninoculated.
1 ...	0	0	0	2*	1	1
2 ...	0	0	0	3*	1	0
3 ...	3	0	0	1	1	1
4 ...	2	1	1	0	0	0
5 ...	2	1	0	0	0	0
6 ...	3	1	1	0	0	0
7 ...	2	1	1	0	0	0
8 ...	3	1	0	0	0	0
9 ...	2	1	1	0	0	0
10 ...	6	0	0	1	1	1
11 ...	2	1	0	0	0	0
12 ...	6	1	0	0	0	0
13 ...	2	1	0	0	0	0
14 ...	3	0	0	1	1	1
15 ...	2	1	1	0	0	0
16 ...	1	1	0	0	0	0
17 ...	1	1	0	0	0	0
18 ...	0	0	0	1	1	1
19 ...	?†	0	0	1	1	1
20 ...	?†	1	1	0	0	0
21 ...	3	0	0	1	1	1

* Survivors inoculated after undergoing fifteen days segregation.

† The exact number of contacts in cases 19 and 20 is not known, but it is known that they are inoculated contacts.

It is interesting to notice that in four instances the only uninoculated person in a dwelling took plague whilst his inoculated contacts escaped. It is also highly significant, I think, that in no instance did an inoculated contact develop plague, and never did more than one case occur in the same room. When one remembers that plague is capable of wiping out, and frequently does wipe out whole families to the extent of half a dozen individuals

or more, I think it is highly significant, that with 21 cases of plague having nearly 50 direct contacts in all, not one single contact took the disease and I do not see that this result can reasonably be put down to anything but the fact that these contacts were all inoculated.

Plague at Engrais Mauricien Camp.

This camp held 70 men and 82 women and children. 30 of the men and 6 of the women and children were inoculated in July. Plague attacked the camp in October and 13 cases occurred in the first fortnight of that month, none of whom were inoculated. The camp was then evacuated and its inmates inoculated with the exception of 37 individuals. After evacuation 8 cases occurred amongst the original inmates of the camp, who had been scattered to various places of segregation. Half of the 8 cases occurred amongst the uninoculated 37, and the other 4 amongst the inoculated remainder of 115. Of the 4 inoculated cases, one developed his first plague symptoms the day after inoculation and another three days after. It is impossible to say with certainty where these people got their plague from whilst they were in evacuation camp but it is certain that altho' they had left the original camp as far as sleeping goes, they nevertheless continued to cook and eat their food there.

Plague in the Albion Dock and Colonial Dock Camps.

These two Docks are of the same type as that of the Mauritius Dock. The inhabitants of both camps were inoculated without exception early in July. Albion Dock contained thereabout 500 and Colonial Dock about 70 men, women and children. Albion Dock has produced 12 cases of plague of which 6 recovered whilst Colonial Dock has produced 10 cases with 3 recoveries.

The results of inoculation in these two camps have been and are now frequently put forward as perfect evidence of the entire uselessness of Haffkine's prophylactic.

In the absence of any uninoculated persons in either of these two communities, who might have served as controls, it is of course impossible to controvert the statement that if both had not been inoculated exactly the same number of cases would have occurred, no less and no more.

With regard to Albion Dock it may be reasonably submitted that a case incidence 1 in 41 is abnormally low for plague anywhere, and when this proportion is put into contrast with the cases of Dry Dock, l'Espérance Estate, Belle Vue (Pilot) 3 uninoculated communities which produced respectively a case incidence of 1 in $3\frac{1}{2}$, 1 in 11 and 1 in 5 (vide inf.) it seems to me that the Albion Dock has done very well indeed. Colonial Dock has undoubtedly given a very high case incidence although inoculated, viz: 1 in 7.—As far as I know it is the only instance in the Island in which Haffkine's prophylactic has not conferred all the protection claimed for it, and I would submit that it is on the face of it ridiculous to draw conclusions from so small a community as 70 persons. Haffkine's fluid protects 80 o/o of persons, the odd 20 o/o have not been immunisable either by one dose of vaccine nor by two doses nor sometimes by a dose of real plague itself, as is evidenced by the occasional occurrence of a second attack of plague in the same individual. An abnormal

aggregation of such non-immuniseable persons all inoculated is possible, and would seem to me to be no very extraordinary coincidence in a total of nearly 20,000 inoculations.

As an instance of what plague can do in an uninoculated community the case of Dry Dock may be taken. Here there lived 35 persons all uninoculated. In little over a fortnight no less than 10 of them had taken plague and 7 were dead. They were hurried into segregation and the outbreak was thus checked.

Again at Belle Vue (Pilot) Estate in an uninoculated Sugar Estate camp 50 cases with 42 deaths occurred in a community of 250.

INOCULATION IN COUNTRY DISTRICTS.

I. Inoculation at Rose Hill-Beau Bassin.

The township of Rose Hill and Beau Bassin was one of the first places to produce plague outside Port Louis. The epidemic there has never been very acute but it has always been steady, an average of a dozen or so cases occurring weekly.

At this date January 16th. occasional cases crop up in the township ; indeed it is one of the very few places left in the Island which still produces plague.

15,000 persons live in this township : of whom 4,047 have been inoculated :

	No.	Cases.	Deaths.
Inoculated ...	4,047	7	4
Uninoculated ...	10,953	100	76

The advantage in favor of inoculation is therefore 81 o/o. The death-rate amongst the inoculated is 55 o/o and amongst the uninoculated 76 o/o.

In this township is a Sugar Estate which employs about 1,500 coolies of whom 940 have been inoculated.

5 cases of plague have occurred amongst the uninoculated coolies and (5) five amongst the inoculated. Bearing in mind the strong susceptibility which many sugar estates in the Island have shown towards producing plague epidemics, the relative immunity of *Stanley* is very remarkable, especially in view of its close proximity to Rose Hill and Quatre Bornes both somewhat strongly infected centres. The only thing which would appear to be abnormal about Stanley Estate as compared to other estates is, that its employés were very early and in large majority inoculated.

II. Inoculation at L'Espérance Estate.

This estate has a coolie camp which in October last held over 1,000 persons. On the 2nd. October a case of plague was discovered in the camp and the last case was registered on December 5th. On October 5th., 159 inhabitants of the camp were

inoculated, and for six weeks no more inoculations were performed because there was no more vaccine left in the Island. 68 cases of plague occurred amongst the uninoculated persons in the camp with 54 deaths whilst 4 cases with one death occurred amongst the inoculated.

	No.	Cases.	Deaths.
Inoculated	159	4	1
Uninoculated	956	68	54

These figures give an advantage in favour of the inoculated of 64 o/o for case incidence, and an overwhelming advantage for mortality incidence. Of course the figure 159 is a small one and it is the greatest misfortune that there was not enough vaccine to inoculate some four hundred or so more persons, as we should then have had an experiment approaching in some degree, the nicety of certain ones carried out in India.

The inoculated cases of plague were mild, two of them being cases of *pestis minor* which probably would not have been diagnosed at all had not an epidemic been in progress.

The most important fact with regard to "L'Espérance" Estate is that as soon as inoculation was completed on November 17th, so soon did the epidemic cease; and that the few cases which did occur after that date were amongst uninoculated remnants to the number of not more than a dozen, who, from sickness or other cause, were unfit for inoculation at the time. The epidemic on the date of final inoculation was showing no tendency to cease, 7 and 8 cases having occurred in the two preceding weeks respectively. Two cases occurred in the first week following final inoculation, and one in the second week following, all uninoculated cases as aforesaid. The epidemic then ceased. During the progress of the epidemic at "L'Espérance" the original coolie camp was gradually evacuated. It has in consequence been put forward that the cessation of plague at "L'Espérance" was due to evacuation and not to inoculation. With regard to this it is only necessary to mention two facts: 1o. that over half the plague cases on the estate took place not in the original camp but in the segregation camp into which the coolies were being evacuated, and 2o. that at the time of final inoculation over 200 persons were still left in the original camp where indeed they reside to this day. I may say that the Manager of the estate, an official who from having watched and fought the epidemic from its commencement to its end, is certainly in a position to judge, is entirely in accord with me in thinking positively that inoculation not merely reduced the mortality and case incidences of plague at "L'Espérance," but caused it finally to cease as soon as it was completely carried out.

Owing to the gradual evacuation which was in progress throughout the period of epidemic it was impossible to make records of systematic house to house visitation.

Nevertheless three huts gave interesting results. In the first lived six persons only, two of whom were inoculated. The

two inoculated persons remained healthy and nursed the four uninoculated who all developed plague and mostly died of it. In the second hut lived eight persons of whom seven were uninoculated—six of the uninoculated took plague and the other two remained healthy. In the third hut lived 6 persons of whom one was inoculated. All six took plague and the only one to recover was the inoculated person.

III. Inoculation at Schœnfeld Estate.

This Sugar Estate lies very near the above estate "L'Espérance". It started with a case of plague on 15th. October. During the third week in November there were 5 plague seizures and everything pointed towards the beginning of sharp outbreak similar to the one in progress in the neighbouring estate. Inoculation was begun on 14th. November and rapidly completed with the exception of about 20 persons who deserted. The last case of plague was registered on the 20th. November, a week after inoculation was commenced. A total of 919 were inoculated. Ten cases in all occurred in the camp all uninoculated and all fatal. No measure of evacuation was attempted in this instance.

IV. Inoculation at Union (Ribet).

The history of this estate is somewhat similar to that of Schœnfeld. It suddenly produced 12 cases of plague between the 30th. of November and 5th. December. The whole camp containing about 420 persons was rapidly inoculated and no further cases occurred. In this instance again inoculation was practically the only preventive measure taken.

V. Inoculation at Souillac village.

This place contains 2,500 inhabitants. For some unexplained reason it rapidly got itself inoculated to the number of over 800 persons. Altho' the district of Savanne in which the village lies was fairly severely stricken with plague only 21 cases took place in Souillac itself and none of them were inoculated.

Further instances of prophylaxis.

J.—Uninoculated, New Mauritius Dock camp, died of plague on 14th. August last. Contacts, six persons all inoculated who remained healthy.

M.—Uninoculated, of Abattoir Road, died of plague on 15th. August last. Contacts, wife and child both inoculated and remained healthy.

J.—A family of five of whom 2 were inoculated. Two of the uninoculated took plague and one died. One of the inoculated took plague very mildly and recovered.

J. J. J.—Uninoculated, died of plague on 25th. July last, a family of five including two infants all inoculated except deceased and the two infants.

R.—Came from country district, slept one night in Albion Dock camp and returned to country where he developed plague and died. As already stated all the 500 odd inmates of Albion Dock were inoculated.

S.—Died of plague at New Mauritius Dock camp. He was not an engaged labourer but was on a visit to the camp where he resided a few days. At that time there were 400 odd inoculated inmates of the camp and thirteen uninoculated.

E.—Uninoculated, died of plague in Camp Coriolis on 24th. October last. Contacts, a woman and child both inoculated remained healthy.

Miss.....—Uninoculated, died of plague at Hazard street on 18th. October last. Contacts, two inoculated persons who remained healthy.

S.—Uninoculated, died, Mauritius Dock Camp, of plague on 21st. November last. One inoculated contact remained healthy.

A. K.—Chinaman uninoculated, died of plague in Royal street on 8th. December last. Four inoculated contacts remained healthy.

Mrs.....—Beau Bassin, uninoculated, died of plague on 8th. December last. Four inoculated contacts remained healthy.

Method of administration of prophylactic.

The vaccine was administered with the usual aseptic precautions.

The needles were immersed after each inoculation in glycerine heated to a temperature of 40° Fahrenheit or over, after the method of Professor Wright's typhoid inoculations. An attempt was made to treat inoculated persons with calcium chloride after inoculation. Each person received free of charge at the inoculation station a dose of 15 grains of calcium chloride which was taken on the spot.

On application at certain Chemists' shops they obtained a bottle containing three more doses of calcium chloride with printed directions to take 15 grains more on the day of inoculation, 10 grains on the day following and five grains on the third day. A dose of purgative medicine was also supplied and the printed directions advised avoidance of alcohol, fruits, &c., for a few days. Every body took the first dose of calcium chloride and I think most people took the rest and followed out the directions more or less completely. Half a dozen cases of abscess at the site of inoculation have been reported to me and probably there have been others, but not many. The abscesses were not serious and caused little inconvenience.

There was a curious case in a boy who was inoculated in June and developed plague two months later. He had gone thro' the usual reaction and was well both as to his arm and as to his general condition within a week of inoculation, when he was seen again he had undoubted plague and on the left arm just at the site of inoculation there presented an inflammatory tumour. This broke down and an ounce of pus was evacuated. He recovered both from his plague and his abscess without difficulty.

With regard to the effect of inoculation apart from prophylaxis there have been many cases where malarial fever has improved, and ever been temporarily cured after it. Some of these cases were very marked having suffered from fever for months before and having no further attacks after the inoculation reaction was subsided.

Rheumatism also seems to be sometimes benefited by inoculation. There was a native servant who had suffered from recurrent attacks of rheumatism for years. A month previous to inoculation he could scarcely walk. He was told to go and be inoculated with a view to curing his rheumatism and not especially for prophylaxis. He certainly got well immediately afterwards.

There is also the case of a gentleman who has been a sufferer from attacks of rheumatism with swollen joints for a long time, attacks which were often complicated by rheumatic iritis and usually lasted 2 or 3 months. I used to see him daily. At the time of his inoculation his rheumatism and iritis were as bad as possible and had been so for a month. Three days after inoculation he was quite well.

Three cases of specific urethritis were watched in view of statements which have been made with regard to the beneficial effect of inoculation in that disease. Inoculation did not improve them in the slightest. I do not think there have been any untoward results after inoculation.

There have been the usual number of cases of urticaria and the usual number of persons whose special idiosyncrasy has caused them to be ill for a month after inoculation, but the majority have been in no way damaged and some there are who say, rightly or wrongly, that their general health has been improved by inoculation.

A return has been made by Lieutenant-Colonel Crétin, I.M.S., with regard to the effects of calcium chloride on the inflammatory reaction which follows inoculation, and which he has kindly allowed me to use. The reactions were classified as "slight" or "marked," "slight" meaning normal.

703 fighting men and 85 followers of the 1st. Bengal Infantry were inoculated.

Some men were given no calcium chloride, some were given calcium chloride after inoculation and some were given calcium chloride both before and after.

Those who got their calcium chloride before and after took 15 grains each dose, the first being given 3 hours before inoculation. The others took 30 grains in two doses sometime after inoculation on the same day. Both took a third dose on the following morning.

The results are as follows :—

Fighting men 703.

20 men had no ch. calc :	{	7 had "marked" reaction or 35 o/o.
	{	13 "slight" " or 65 o/o.
275 men had cal. chl. after	{	88 "marked" " or 32 o/o.
inoculation.	{	187 "slight" " or 68 o/o.
408 had cal. chl. before	{	17 "marked" " or 4 o/o.
and after inoculation.	{	391 "slight" " or 96 o/o.
85 followers had cal. chl.	{	2 "marked" " or 2 o/o.
before and after inoc :	{	83 "slight" " or 98 o/o.

one follower fainted, one sepoy had an abscess—all the others did well. 5 men had no fever and slight local reaction. The men lost 3 lbs. weight daily during the first 3 days.

Afterwards they gained weight at the same rate.

SUMMARY OF RESULTS OF INOCULATION.

Total number of persons inoculated in Colony	...	...	...	...	=	19,418
„ of inoculated plague cases in Colony	...	...	...	...	=	75
„ of uninoculated plague do.	...	...	...	...	=	1,349
Death-rate amongst uninoculated for whole Colony	...	...	...	...	=	78 o/o
„ „ inoculated „ „	...	...	...	...	=	54 o/o

		Numbers un- inoculated.	Cases amongst uninoculated.	Death-rate amongst uninoculated.	Numbers in- oculated.	Cases amongst inoculated.	Death-rate amongst inoculated.	Case incidence protection.	Remarks.
1. Port Louis	...	47,184	826	86 o/o	6,816	66	57 o/o	44 o/o ?	No conclusion can be drawn from these figures as two of them are quite uncertain, viz : those marked ? 44 o/o represents the minimum possible prophylaxis. As regards figure 66 it includes 10 cases which developed within 10 days of inoculation probably therefore either during the incubation period of plague or at least before full prophylaxis. There is a mortality incidence advantage of 29 o/o in favour of inoculation which rests on certain figures.
2. Mauritius Dock Camp	{	13	7	85 o/o	423	13	46 o/o	94 o/o	First set of figures before partial evacuation.
		39	8	87 o/o	319	13	46 o/o	80 o/o	Figures after partial evacuation.
3. Engrais Mauricien Camp.	{	116	13	72 o/o	36	...	...	...	Figures before evacuation.
		37	4	...	115	4 ?	...	...	The figure 4 in column 5 has a note of interrogation because two of the cases were inoculated during the incubation period of plague.
4. Rose Hill & Beau Bassin.		10,953	100	76 o/o	4,047	7	57 o/o	81 o/o	
5. L'Espérance Estate	...	956	68	79 o/o	159	4	25 o/o	64 o/o	Plague after lasting two months ceased when inoculation was completed.
6. Schœnfeld Estate	...	919	10	100 o/o	...	...	...	...	Five cases in 3rd. week of November. Inoculation "en masse" carried out during that week. Plague ceased.
7. Union (Ribet) Estate	...	420	12	66 o/o	...	...	...	...	Twelve cases during 1st. week of December. Inoculation "en masse" carried out during that week. Plague ceased.
8. Souillac	... ..	1,200 to 1,500	21	81 o/o	828	...	...	...
9. Bassin Estate	... ..	366	33	...	425	1	...	...	This estate still produces plague fairly regularly. The figures are up to 25th. January 1900.

CONCLUSION.

In coming to a conclusion with regard to the value of preventive inoculation for plague it is necessary to compare the good results with the bad and to strike a balance between the two. There have been two bad results in the Colony, one Colonial Dock, which is absolutely bad and the other, Port Louis, which is comparatively bad. With regard to the first, a possible explanation has been put forward or rather an explanation has been put forward which appears to me not only possible but probable.

In any case, the instance of so small a community cannot be put forward against the amount of evidence which remains. Port Louis is a bad result only comparatively as a substantial balance of protection has been shown, and further inoculated plague seizures have recovered 29 o/o better than uninoculated seizures. I think enough has been put forward to explain the comparatively bad result obtained in Port Louis. Mauritius Dock has given an excessively good result and a result which is based upon certain figures, large figures, and a long period of observation; that is to say, it has the three essentials laid down for the making of good statistics.

Rose Hill and Beau Bassin again give a very good result. The figures have been kept by Mr. Hugnin, the President of the Board of Commissioners for Rose Hill and Beau Bassin, who has kindly allowed me to use them. Engrais Mauricien and Souillac give good results also, but they are merely indications as the figures are so small. L'Espérance, Schoenfeld and Union (Ribet) are three estates which produced no more plague almost from the day they were inoculated. Bassin Estate is giving good results but as the outbreak there is not over, it would be premature to draw conclusions now.

In conclusion, I repeat that Haffkine's prophylactic gives 80 o/o protection for case incidence and something over 20 o/o for mortality incidence. Furthermore, I believe that if the whole of a large community be inoculated and one half of it re-inoculated plague must cease in that community. This is no wild statement. It has been done before in Hubli, a town of about the same population as Port Louis, which in 1898 suffered an epidemic of plague of a virulence which can scarcely be conceived by people who look upon the recent one in Mauritius as severe.

J. S. STEVENSON,

Captain, I.M.S.

30th. January, 1900.
